^{40}AR-^{39}AR AGE DIFFERENCES ACROSS PETROGRAPHIC BOUNDARIES IN MESOSIDERITES.

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Introduction: Mesosiderites are polymict breccias [1]. Their early evolution extended over 0.7 Ga [2-5] and included metal-silicate interactions that altered element distribution and produced a suite of late crystallizing minerals (pyroxene, phosphate, tridymite) [1, 6-9]. Chronometric data for mesosiderites are often disturbed [10-11]. Laser ^{40}Ar-^{39}Ar dating of feldspar crystals in petrographically constrained samples minimizes the mixing of signals from inclusions with different histories and can elucidate the origin of local features.

We studied five samples from Vaca Muerta (VM), one from partly homogenized, metal-bearing matrix and four on a profile through a mafic clast attached to the matrix. The ages are bimodal. The 2-cm, metal-poor mafic clast was partially metamorphosed by hot metal invading the matrix. Laser ^{40}Ar-^{39}Ar chronometry reveals significant age heterogeneity over less than 1cm. Nominal plateau ages range from 4.02±0.03 Ga (70% ^{39}Ar) in the matrix to 4.3±0.1 Ga (65% ^{39}Ar) in the deep interior of the clast. The clast margin gives an intermediate value of 4.1 Ga.

Discussion: The 4.3 Ga age of the deep interior reflects the least Ar disturbance, and is consistent with crystallization ages from disturbed Sm-Nd dates (~4.4Ga) for similar material [3,5] and with ^{53}Mn-^{53}Cr evidence for initial crystallization 4.5+ Ga ago [11]. Phosphate in mesosiderite is a metamorphic product of oxidation of metallic P [7] and dominates REE budgets. REE based dates and REE patterns also reflect that metamorphic event. The differences between Ar release patterns of the metal-bearing silicate matrix and the metal-free mafic clast suggest that metamorphism was associated with metal injection and was active 3.9-4.0 Ga b.p., and perhaps as late as 3.6 Ga. Shock features produced by early brecciation were probably annealed out during the metamorphism. The absence of shock signatures in either matrix or clasts reduces the likelihood of post-metamorphic impacts [12].

The new Ar data provide two options. The metamorphism was late, and slightly disturbed the (refractory) Sm-Nd ages but reset (volatile) Ar more completely, or alternately it was early, as suggested by the REE ages [5], but permitted Ar diffusion until at least 3.9 Ga. Age differences across VM profiles provide constraints for refined cooling rate calculations correlating Ar diffusion with observed path lengths, with REE closure and track data to explore these options.

References: 1. *Powell*, 1971 GCA **35**:5; **2.** *Bogard & Garrison*, 1998 GCA **62**:1459; **3**. *Brouxel & Tatsumoto*, 1991 GCA **55**:1121; **4**. *Haack et al*., 1996 GCA **60,** 2609; **5**. *Stewart et al*., 1994,GCA 58:3487; **6**. *Delaney et al*., 1981 PLPSC, **12B**:1315; **7.** *Harlow et al*., 1982 GCA **46**:339; **8**. *Nehru et al.,* 1980 GCA, **44**:1103; **9**. *Petaev et al*., 2000 Geochem Int,. **38:**322; **10**. *Bogard et al.,* 1990 GCA **54:**2549; **11**. W*adhwa et al.,* 2003 GCA **67**:5047; **12.** *Rubin & Mittlefehldt,* 1992 GCA **56:**827.